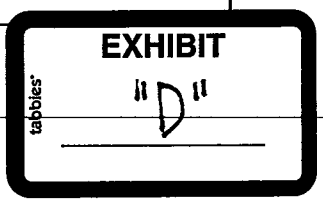
IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF OKLAHOMA

W. A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA and OKLAHOMA SECRETARY OF THE ENVIRONMENT C. MILES TOLBERT, in his capacity as the TRUSTEE FOR NATURAL RESOURCES FOR THE STATE OF OKLAHOMA,	
Plaintiff,	
vs.	4:05-CV-00329-TCK-SAJ
TYSON FOODS, INC., et al,	
Defendants.	

- -

VOLUME I OF THE VIDEOTAPED DEPOSITION OF VICTOR BIERMAN, PhD, produced as a witness on behalf of the Plaintiff in the above styled and numbered cause, taken on the 14th day of April, 2009, in the City of Tulsa, County of Tulsa, State of Oklahoma, before me, Lisa A. Steinmeyer, a Certified Shorthand Reporter, duly certified under and by virtue of the laws of the State of Oklahoma.



Page 54

correct?
A That's correct.
Q Okay. It says testified at trial in state circuit court; correct?
A That's correct. Is there -- I thought that's what I was doing, but just for clarity, I wanted to disclose to you that it was before an administrative law judge. 10:32AM
Q Okay.
A So there wouldn't be any mistake in the record. 10:33AM
Q That's fine. I mean, that's our area of expertise, not yours, and so it wasn't before a jury?
A No, it was not. 10:33AM
Q Okay, and your recollection is today that the testimony you gave in that case was before an administrative law judge on a permit-type hearing, for example?
A No. It wasn't a permit-type hearing. The judge actually found for the plaintiffs and fined the chemical company a hundred thousand dollars. So it must have been more than a permit. 10:33AM
Q But you remember him as being an administrative law judge? 10:33AM

Page 55

A Well, that's my recollection, but as you point out, that's not my primary area of expertise, and it was 13 years ago so that could be in error.
Q Fair enough. Dr. Bierman, in this case that's currently before the court here in Oklahoma, did you perform your own investigation of sources of phosphorus in the IRW? 10:34AM
A That's a broad question, so I'll answer it by saying that I performed the investigations of sources that I described in my expert report. 10:34AM
Q Okay. The way I read your expert report is that you evaluated other people's work of identifying sources; correct?
A That's correct.
MR. BOND: Object to the form. 10:34AM
Q Okay. So I guess what I'm asking is, you did your own independent evaluation of what the sources of phosphorus are in the IRW?
MR. BOND: Object to the form.
A I'll explain what I did and you'll have to decide how to characterize it. We did, as I described in my expert report, use the LOADEST statistical model to compute total phosphorus and soluble reactive phosphorus loadings at the three USGS stations -- the last three USGS stations above 10:35AM 10:35AM

Page 56

Lake Tenkiller. So that involved computation of loadings. If that's what you mean by conducting an independent investigation of sources, we did that, but I'm not sure that's what you mean by your question. 10:36AM
Q Well, when you determined the loadings to Lake Tenkiller, that's what you are referring to in the LOADEST; correct?
A That's correct.
Q Did you determine the sources of the phosphorus that were contained within those loadings? 10:36AM
A But not during determination of those loadings, no. We just determined the loadings at those locations. 10:36AM
Q Did you -- at any time in your report do you specify the sources of phosphorus that are entering Lake Tenkiller?
A I did not conduct as part of this investigation, nor is there in my expert report -- back up. I did not conduct any independent investigation of phosphorus sources, and I believe in my expert report there is -- I do not express any opinions on -- I'll stop there. I think that answers your question. I did not conduct any 10:36AM 10:37AM

Page 57

independent investigation of phosphorus sources.
Q Can I ask the same question with regard to bacteria? Did you do any evaluation of sources of bacteria to the waters of the IRW as part of your work in this case? 10:37AM
A No, I did not.
Q The report that's Exhibit 1 before you, sir, does it contain all the opinions that you're prepared to give in this case?
A Yes, it does. 10:37AM
Q Did you do any work or analysis as part of your work in this case that's not contained in your expert report?
A I produced over 124,000 files, which consist -- which contain 197 gigabytes of information. That's my body of work and, of course, not all of that is in this expert report. 10:38AM
Q Yeah. Let me see if I can ask a more specific question. Did you form any opinions -- let me strike this. Did you perform any major analysis or evaluation that's not reflected in your expert report? 10:38AM
A What do you mean by major?
Q Well, let me ask it another way, a more specific question. Did you prepare a water quality 10:38AM

Page 58

model for the IRW?
A No, I did not.
Q How about for the Lake Tenkiller?
A No, I did not.
Q Are you aware of any -- 10:39AM
A Excuse me, sir. Let me -- just so there's full disclosure, I did not prepare any. I did investigate the SWAT report, SWAT work done by Dan Storm, and we conducted some investigation of the HSPF model that was originally done by Tetra Tech, 10:39AM and I think some follow-up work had been done by AQUA TERRA, but they were not independent investigations I conducted. They were investigations of others' work.
Q But you reviewed those models? 10:39AM
A I reviewed the work, right.
Q Okay. My question was more directed -- and I appreciate you being complete, Dr. Bierman. I think that's what they always mean when you say to tell the whole truth, and I appreciate that. Did you 10:39AM actually prepare a water quality model, though, for Lake Tenkiller, your own shop prepare your own model?
A No, we did not.
Q And the same for Lake Tenkiller or the rivers; 10:40AM

Page 59

correct?
A That's correct.
Q Are you aware of -- have you had a chance to review the other expert reports in this case provided by the defendants? 10:40AM
MR. BOND: Object to the form.
A I have read some of them.
Q Okay. In those reports that you've read, can you recall whether any of the defendants' experts' reports you've read identify sources of phosphorus 10:40AM in the IRW?
MR. BOND: I'm going to object to the form of that question.
A I need to refer to my report, please.
Q Certainly. 10:40AM
A Please repeat the question.
Q I was asking whether or not you were aware of any other expert retained by the defendants in this case that have given an opinion as to sources of phosphorus within the IRW. 10:41AM
A On Page 11 of my expert report --
Q Yes, sir.
A -- last paragraph, I read the expert report by Dr. Ron Jarman, and this last sentence cites land application of biosolids from WWTPs and WWTP 10:42AM

Page 60

bypasses and overflows. I cite them -- I state them as sources, and I got that information from Dr. Jarman's report.
Q Okay. Any others that you can identify from the work you reviewed? 10:42AM
A Not that I recall outside of what is contained on Page 11 of my report where I make reference to a number of other published reports which state sources.
Q On Page 11? 10:43AM
A Yes.
Q Could you give me an example other than Dr. Jarman's citation, sir, so I can understand what you are referring to?
A Right. Fourth paragraph, the Comprehensive 10:43AM Basin Management Plan For the Illinois River Basin in Oklahoma by Haraughty 1999. I'm not sure if I'm pronouncing that correctly, but it's spelled H-A-R-A-U-G-H-T-Y. That's a 1999 report that listed the following sources of phosphorus that I have 10:43AM bulleted out underneath that paragraph. That's one example. Another example would be Urban Runoff in Golf Course Fertilizer Application, and those sources are stated in Appendix B of Dr. Engel's report. 10:44AM

Page 61

Q Okay. This work by Haraughty, I don't know if I pronounced that right, but it's H-A-R-A-U-G-H-T-Y, were those all the sources that Haraughty identified or was this just some of the sources that you've listed here on Page 11 of your report? 10:44AM
A I can't recall. My intention in supporting Statement 2D was to enumerate all of the other sources, besides poultry litter phosphorus, that I had read about in reports or other expert witness reports. 10:44AM
Q Does Haraughty provide any analysis of relative contribution of these sources of phosphorus?
A I can't recall.
Q Did you do any evaluation yourself, sir, to 10:45AM determine the relative contribution of these sources you've listed on Page 11 to phosphorus in the IRW?
A No, I did not.
Q Dr. Bierman, as part of your work, did you determine how much phosphorus reaches IRW streams 10:45AM from land application of poultry waste?
MR. BOND: Object to the form.
A Did I --
Q Do that evaluation.
A I did not conduct any independent evaluations 10:45AM

Page 62

of phosphorus from poultry litter that makes it to rivers and streams in the IRW.
Q I guess the same question for Lake Tenkiller: You didn't do any independent evaluation as to what phosphorus land-applied poultry waste in the IRW reaches Lake Tenkiller? 10:46AM
MR. BOND: Object to the form.
A I did not conduct any independent investigations of the transport or delivery of phosphorus from poultry litter from fields in the IRW to Lake Tenkiller. Is that responsive to your question? 10:46AM
Q Yes, sir, thank you. And, Dr. Bierman, are you providing any opinions in this case, which would characterize the relative contribution of phosphorus from different sources in the IRW, for example, an opinion that cattle contributes more phosphorus than poultry, for example? 10:46AM
A I am not providing that opinion.
Q Or any kind of relative contribution opinion at all? 10:47AM
A I'm not providing any opinions of the relative contribution of poultry litter to phosphorus loads to streams and rivers or to Lake Tenkiller based on any independent investigations I have conducted. 10:47AM

Page 63

Q I'm going to ask this question. I know you probably mentioned some of them but I'm going to try to make sure I've got the full scope of your experience the best we can recall today. You've mentioned a couple of cases where you've evaluated non-point source pollution. I think one of them would be Saginaw Bay we recently talked about. I think there was one perhaps with PAHs running off potentials. Other than -- 10:48AM
A Excuse me. The PAH case I did the receiving water model, recall. One of the other experts had done the land site loading determinations in that case. 10:48AM
Q Okay. Other than what we've talked about so far today in your deposition, do you recall any other work where you've done an analysis of non-point source pollution? 10:48AM
A May I refer to my CV?
Q Absolutely, sir.
A Okay. Okay. I'm here. 10:49AM
Q Can you identify the page you're looking at, sir?
A I'm sorry. Page A-6.
Q Thank you, sir.
A I will start with the more recent projects and 10:50AM

Page 64

work backward in time.
Q Okay.
A The second project under selected experience --
Q Uh-huh. 10:50AM
A -- Review of Watershed and Water Quality Models For Nutrient TMDLs in the Caloosahatchee River estuary. TMDLs, of course, means total maximum daily loads. The --
Q Please go ahead. 10:50AM
A I conducted an independent scientific review of a coupled watershed receiving water model. The HSPF model, watershed model had been applied to the entire Caloosahatchee River watershed. I assessed the watershed model and the receiving water model. 10:50AM
The issue was nutrients and dissolved oxygen.
Q So the HSPF model was coupled with what other to evaluate the watershed in that case?
A The HSPF model was the watershed engine, loading engine so to speak. The outputs of the HSPF model were used as inputs to the EFDC receiving water model in the estuary. 10:51AM
Q And what did you find in that evaluation?
A Well, I conducted a review of the work and I provided about seven or eight pages of comments. 10:51AM

Page 65

This model was put forth by the Florida Department of Environmental Protection for use as the modeling platform to develop nutrient TMDLs for the Caloosahatchee River estuary.
Q Okay, and what was the runoff model that was used on that TMDL analysis? 10:51AM
A Well, HSPF was the -- HSPF is the watershed model, and that includes non-point source runoff.
Q And were you personally the one who evaluated the sufficiency of the HSPF runoff model in that case? 10:52AM
A I was personally involved as was a staff person.
Q Okay, and what evaluations did you perform on the HSPF model for that particular TMDL? 10:52AM
A We evaluated the input data, the site-specific application, the calibration results, comparisons of model output to data.
Q Anything else?
A It's the things that one would -- 10:53AM
Q Did you find that the HSPF model was sufficient to model the watershed loads for that river estuary?
A I need to draw a distinction between HSPF as a modeling tool, a modeling platform, and this 10:53AM

Page 82

during his deposition, that is, I've run it perhaps half a dozen times.
Q The GLEAMS model?
A Yes, sir. As Dr. Engel stated in his deposition, he's not the man at the switch running the model every day. 11:28AM
I work in a similar mode. I have 35 years of experience, and I work with highly trained, highly qualified, highly motivated staff on this and many of my other projects. In particular, I've worked with four principal staff on this investigation. 11:28AM
Just the four principal staff I've worked with have a combined total professional experience of 85 years. I have personally worked with these people for 62 years. In addition, there have been three, four, half a dozen other people involved from time to time in this project. I don't work in a vacuum, sir, and neither does Dr. Engel, neither does anyone who has been at 35 years of professional experience in my field. 11:28AM 11:29AM
Q Okay. Well, what I want to do, though, sir, is I want you to tell me about your personal experience throughout 35 years, not today maybe, but throughout your 35 years of experience, how much personally have you done on upland modeling? 11:29AM

Page 83

A Are you asking me how many times I've been the man at the switch actually running the model?
Q Yes.
A A small number of times, perhaps a dozen.
Q Okay. Have you published any of your work concerning -- let me strike that. Have you published anything in a peer-reviewed journal that relates to uplands watershed modeling, any papers? 11:29AM
A The paper on the Everglades water quality modeling was published in the journal called Ecological Modeling. 11:30AM
Q Okay, and what runoff model was used in that particular case?
A That was the south Florida -- that was the runoff model that was built on the -- well, it's called the Everglades water quality model actually. Hydraulic portion of it was the so-called two-by-two model. We developed a new model based on that hydraulic foundation, and we added phosphorus and chloride to it and modeled phosphorus and chloride in the overland areas and the canal systems of south Florida, and we named it the Everglades water quality model, and that's what we called it. 11:30AM 11:30AM
Q Any other peer-reviewed journal publications where you've personally done work on runoff 11:30AM

Page 84

modeling?
A No. I have several papers published on tributary load estimation using tools that were actually predecessor tools and were later incorporated into LOADEST. I'm not sure that that answers your question, but I'm just disclosing that because it touches on the topic of loadings. 11:32AM
Q Doesn't LOADEST primarily focus on in-stream processes?
A That's correct. 11:32AM
Q I was asking field runoff. Nothing else?
A No.
Q How often have you worked with the GLEAMS model, not including this project?
A The GLEAMS model as a tool or the process-based deterministic mass balance science in GLEAMS? 11:32AM
Q No. I'm talking about the GLEAMS model as a tool.
A Not before this project. 11:33AM
Q What about the SWAT model; how often have you used that model as a tool?
A I have not used SWAT.
Q And HSPF, I think you identified a couple of projects that you worked with it. How often have 11:33AM

Page 85

you used the HSPF model?
A I think it was more than a couple of projects. It might have been five or six. The record will show the exact number, but it's more than two. I'm sorry, the rest of the question was? 11:33AM
Q Then I guess my other question, do you recall any other watershed field runoff models that you've worked with other than HSPF?
A Unit area load models.
Q Where you used like the spreadsheet analysis? 11:34AM
A Yes.
Q Okay.
A The Everglades water quality model. That would be it. I should point out that Dr. Engel in his deposition, and I think I agree with him, pointed out that HSPF is a more complex and more sophisticated model than GLEAMS. It is a watershed model as opposed to a field scale model, and it is more complex and sophisticated. 11:34AM
Q I'm going to move to strike as not being responsive to any question. 11:34AM
Dr. Bierman, did you or your group perform any field investigations in the IRW?
MR. BOND: Object to form.
A We did not take samples in the field. I 11:35AM

Page 86

did -- I'm not sure if this qualifies but I want to disclose it so I'm giving you a complete answer. I did spend several days in the watershed, and it involved being on the water for several days, the Illinois River, but I did not take any samples. 11:35AM

Q Or perform any scientific analysis other than your visual observations?

MR. BOND: Object to form.

A Well, okay. Let's go back to square one. I have not -- neither myself nor my team has conducted 11:35AM any sampling in the Illinois River watershed. My personal experience -- my -- I did visit for several days and observe. We made observations at numerous points in the watershed and on the water itself. That was an observational trip only. 11:36AM

Q Okay. When you say -- let me back up here. How many days have you been in the IRW where you've actually done observation work?

A I guess it depends on how you count. I visited Fayetteville a number of times, but I was 11:36AM out in the -- this trip lasted -- it was about two years ago. I can't remember. I think it was three or four days.

Q I'm not talking about when you were visiting an office in Fayetteville. 11:36AM

Page 87

A No, no. Out in the field -- we were out in the field for three or four days, myself and some of the other defendants' expert witnesses.

Q And that was two years ago?

A I think it was in summer of 2006 actually. 11:37AM

Q Any other field work you've done in the IRW?

A No.

Q What observations did you make when you were out in the field?

A Well, it's a broad question. I made many 11:37AM observations over four days and there were many pictures that we took.

Q Did you produce all your photographs?

A Yes.

Q So what did you do? I'm just trying to 11:37AM understand what you did for three or four days within the Illinois River watershed.

A Part of it involved driving to different sites. Well, back up. The question is broad. I'll try to be responsive, and if you want more detail, 11:38AM I'll need to refer to my photographs. I observed pastures. I observed poultry houses. I observed -- I think we observed at one point a wastewater treatment plant. We observed the large nursery on the shore of Lake Tenkiller. We observed eroded 11:38AM

Page 88

stream banks. I observed cattle in the riparian zone. I observed cattle in the stream. I observed cattle defecating in the stream, things of that nature.

Q Did you notice any filamentous green algae in 11:38AM the streams?

A I observed algae in the stream. I didn't know if they were filamentous green algae or not. One would need to have taken a sample and looked under a microscope to confirm the algal identification to 11:39AM give an exact answer to your question, and I did not do that. So I may have observed it in the sense that I may have seen it, but I didn't know necessarily if it was filamentous green algae.

Q Did you see any algae attached to rocks on the 11:39AM streambeds or the sides of the stream?

A Yes.

Q Did you observe any poultry waste land applied in the IRW when you were out there?

MR. BOND: Object to form. 11:40AM

A Did I observe the application process?

Q Yes, sir.

A I don't recall that I observed that. I could have, but I can't remember.

Q Do you know how poultry litter is applied in 11:40AM

Page 89

the IRW?

A I've read about how it's applied, but I can't recall the details sitting here.

Q You didn't do any study of poultry litter application in the IRW, how it's applied, when it's 11:40AM applied?

A I did not conduct independent studies of those things.

Q You reviewed what Dr. Engel -- analysis, for example? 11:40AM

A Well, I read Dr. Engel's report. I also read reports by other of the plaintiff's experts, and I've read some of the reports of the defendants' experts, and I'm sure I've read descriptions of that operation, but I don't recall the details. 11:41AM

Q Are you offering any opinions concerning the methods of poultry litter application in the IRW?

A The methods?

Q Yeah.

A No, I'm not. 11:41AM

Q Or the timing?

A Only insofar to point out, as I did in my expert report, that Dr. Engel's model represents all the poultry litter as being applied once a year in a single heap. Whereas, data in another portion of 11:41AM

Page 110

waste storage lagoons.
Q Okay. Do you agree with that statement, sir?
MR. BOND: Object to form.
A From agricultural lands? Well, as a broad general statement, qualified by the words primarily, 01:16PM
I don't have a disagreement with that part of it as a broad statement but, again, it depends on what happens in any particular site or watershed can be very different. I don't frankly understand as well as by direct discharges from animal waste storage 01:16PM
lagoons. I suppose that could be a potential source, but I would not sit here and agree that that is one of the primary sources.
Q What; the discharges from animal waste storage lagoons? 01:17PM
A Yes. I'm not familiar enough with discharges from animal waste storage lagoons to express an opinion about that part of that sentence.
Q What evaluation have you done to determine that the transport of phosphorus from runoff varies 01:17PM
from watershed to watershed?
MR. BOND: Object to form.
A What analysis have I done --
Q Yes.
A -- or what scientific literature and reports, 01:17PM

Page 111

what am I familiar with? Is it --
Q Let's start with first your analysis and then we'll go to the second.
A I've done quite a bit of work in the Lake Okeechobee watershed, and I know the characteristics 01:18PM
of the soils and the topography of the land in south Florida, especially the Everglades agricultural area, are quite different from agricultural areas, say, in the upper Midwest.
Q Okay. Have you done any evaluation to 01:18PM
determine whether it affects runoff from manures being applied to those lands?
A I have not conducted any of those evaluations, no.
Q Have you reviewed literature concerning those 01:18PM
issues, sir?
A Concerning the issues of --
Q Of runoff from agricultural lands where manure has been applied.
A I've reviewed many papers and reports which 01:18PM
contain that information, but I have not specifically done a literature search or survey directed at that particular topic.
Q Okay. Let's skip the next sentence and read the next two after that where it starts the amount 01:19PM

Page 112

required.
A The amount required for crop production is determined by a variety of soil extraction procedures that measure plant available P, in quotes. 01:19PM
Q And the next sentence, sir?
A When available P levels at the soil surface exceed threshold levels at which there is no further response by the crop, in parens, Sharpley, et al, 1994, the potential for P losses to surface waters 01:19PM
increases.
Q Do you agree with that statement, sir?
MR. BOND: Object to form.
A Well, this appears to be a statement based on the Sharpley, et al, paper, 1994, and sitting -- I'm 01:20PM
not familiar with that paper. I don't have any reason to disagree with this statement, but I certainly would not want to be in a position of expressing an opinion about whether I would agree with it because I've not conducted any detailed 01:20PM
investigations of this topic.
Q Have you conducted any investigations of the relationship between the phosphorus concentration in the soil and whether or not that will affect the runoff of phosphorus from that soil? 01:20PM

Page 113

A Again, I've read papers and reports, but I have not conducted my own independent investigations directed at that topic.
Q Okay, and those papers that you reviewed, do they agree that as phosphorus concentrations of 01:21PM
soils increase, all things being equal, that runoff from those soils, phosphorus, increases?
MR. BOND: Object to form.
A It's my recollection from reading these papers and reports that if there's more phosphorus in the 01:21PM
soil, then it's more likely that runoff will occur during a precipitation event. I think that's just consistent with common sense. I have no reason to disagree with it.
Q Have you studied any reports, sir, concerning 01:22PM
phosphorus concentrations in the upper Midwest as relating to fertilizer and manure applications?
A Again, I'm sure that I've read reports -- I've read reports or papers that describe that but I have not studied it in any detail. 01:22PM
Q Have you investigated any reports within the Illinois River watershed concerning the increase of phosphorus concentrations in soils over time?
A I can't recall reading specific reports addressing phosphorus increases over time. I've 01:22PM

Page 114

read many reports in this case, government reports, reports in the peer-reviewed literature, plaintiff's and defendants' experts' reports, and there was much discussion of phosphorus levels in soil and runoff, but I can't pinpoint any specific paper or I can't 01:23PM
give you a specific opinion that I have formed pertaining to those processes.
Q Would you turn to Page 89 of this NOAA report, Exhibit 2?
A Yes. 01:23PM
Q Under Section 3.3.1, would you read that, sir? What's the title? Read the title.
A Approach to Forecasting Simulations.
Q Was this part of the report that you worked on? 01:24PM
A Yes, it was.
Q And wrote?
A Uh-huh.
Q Okay. What kind of forecasting simulations just in general were performed as part of this 01:24PM
study?
A Forecasting simulations that were designed to answer the following question: If we increase the delivered nitrogen loadings and phosphorus loadings and nitrogen and phosphorus loadings together to the 01:24PM

Page 115

Gulf of Mexico by certain percentages, what response would the model compute in terms of chlorophyll and dissolved oxygen.
Q So when you did that forecast simulation, did you just simply change the phosphorus and/or 01:24PM
nitrogen loadings and see what the model would predict then as far as hypoxia is concerned?
MR. BOND: Object to form.
A Yes, that's what we did.
Q When you did those forecasts, did you modify 01:25PM
the weather or climate parameters for each forecast?
A No, we didn't because the objective was not to forecast actual future conditions but the purpose, as it states in the sentence beginning with rather, comma, this is under 3.3.1, the purpose was to 01:25PM
investigate whether loading reductions of 20 to 30 percent were sufficient to produce a water quality response or whether reductions of up to 70 percent may be required to produce a response. Again, your objective was to determine how responsive the system 01:25PM
was to changes in nutrients, not to predict actual future conditions.
Q But isn't that what Dr. Engel did in his forecast, that is, to see whether or not the change in manure application in the watershed would produce 01:26PM

Page 116

an effect in Lake Tenkiller?
A Dr. -- my understanding is that Dr. Engel conducted forecast simulations. I would need to look at the section of his report to see exactly how he characterized those results, just as I've 01:26PM
characterized mine here -- rather the purpose of his simulations.
Q Okay. When you did these simulations for NOAA, did you make any modifications when you changed the nutrient inputs to land use? 01:26PM
A Implicitly -- well, I did not make changes to land use. Implicitly land use changes were represented in the simulations because the non-point source runoff of nitrogen and phosphorus is a major component of the delivered loads; therefore, the 01:27PM
percent reductions in delivered loads would have had to involve some type of management actions on the land in order to achieve those reductions. So implicitly that's what they represented, although I -- this model here was just the receiving model 01:27PM
water, not the watershed model.
Q Was there any changes in human population in the simulations?
A Same answer. They could have been implicit, but they certainly were not explicit. 01:27PM

Page 117

Q Dr. Bierman, did anyone from LimnoTech assist you in your analysis that's set forth in your report?
A I had staff working with me on the project, and they did conduct analyses. Yes, they did assist 01:28PM
me.
Q Okay, and did any of those staff that assisted you in your analysis also assist you in the writing of your report?
A No. I wrote every word of that report, except 01:28PM
in sections that I've indicated are quotes and citations from other papers.
Q Okay. Did you even write the first drafts of all the sections of the report?
A Yes, I wrote everything. 01:28PM
Q Okay. Who was it at LimnoTech that assisted you with your analysis, if you could identify them by name and the major areas, just big areas where they assisted you?
A Okay. I'll start with the four staff who 01:29PM
worked most of the -- the four principal staff. Dr. David W. Dilks, that's D-I-L-K-S. He assisted me with the GLEAMS model, the routing model. He has expertise in watershed and water quality modeling.
Q Okay. Has he ever worked with the GLEAMS 01:29PM

Page 142

models, did they do that evaluation to identify sources of contaminants in waterways?
A I've seen it used for contaminants; I've seen it used for nutrients.
Q Okay. In the NOAA work that you were a part of, did the investigator for sources in the NOAA work employ a mass balance approach to determine sources of nutrients in that study? 02:08PM
A My recollection of the work done that Goolsby did in the Task 1 report, and I believe that's the report in which the loadings were done, he did use mass balance, among other -- I believe he did include mass balance as one of his approaches. However, what Dr. Goolsby did was identified sources on the land and explicitly looked at the delivery of those sources to the receiving water streams, and as part of the overall study, those loadings were delivered to the Gulf of Mexico, the point being that there was -- that study involved the explicit addressing of loads moving from land to water and then from the stream and river network to the Gulf of Mexico, which was really the ultimate objective of that study. 02:09PM 02:10PM
Q Does Dr. Goolsby, when he looked at those transfers from the watershed of the mass balance 02:10PM

Page 143

into the streams, did he use runoff coefficients --
A I don't recall --
Q -- of non-point sources?
A I don't recall what he did. It was ten years ago, and I certainly don't, sitting here, have a detailed knowledge of his method, and I'm not going to speculate on what he did. 02:10PM
Q Did you do any study to determine whether or not the mass balance results that Dr. Engel performed were related to the sources of phosphorus found in the rivers and streams of the IRW? 02:10PM
A If you're asking did I conduct an independent analysis of sources?
Q And to see whether or not there was a relationship between what Dr. Engel found with his mass balance study and the sources that were in the IRW streams. 02:11PM
A I did not conduct any independent analysis to investigate the individual sources that Dr. Engel included in his mass balance. I simply reviewed what he had done, and I put forth this opinion about his results. 02:11PM
Q Would you read the last sentence on the second paragraph, first full paragraph at the top of 4 that says this claim? 02:11PM

Page 144

A Yes.
Q Would you read that for the Record, please?
A This claim is based on Dr. Engel's phosphorus mass balance and is a completely misleading representation of the relative contribution of poultry litter phosphorus to water quality impacts in the IRW. 02:12PM
Q Okay. If you didn't do your own study to determine what the relative contributions are of poultry litter versus other contributions, what's your basis for that particular statement? 02:12PM
A Actually it's just common sense because the only way that water quality, that is, water quality in streams and rivers in the IRW or in Lake Tenkiller, could be impacted by phosphorus loadings is if one explicitly considers the loading of phosphorus from sources based on land to the receiving streams and rivers or to Lake Tenkiller, and Dr. Engel's mass balance in Appendix B of his report simply did not do that. 02:12PM 02:13PM
Q On the next paragraph, the middle of the paragraph, let me read, from materials produced by Dr. Engel, the total phosphorus mass in the IRW soil in his GLEAMS model is 6,370,989 tons. This reservoir represents the sum of phosphorus mass for 02:13PM

Page 145

actual conditions, 1997 to 2006, in all horizons, layers in his GLEAMS model. The bottom depth of these soil horizons range from 15.24 to 83.93 inches, depending on location, and then you go on to say that the poultry contribution would only represent .07 percent of this total phosphorus mass; correct; is that essentially what -- 02:13PM
A Well, I said what I said, and you read. Of course, I wrote what you read.
Q Okay. How much of this total phosphorus mass is actually available for runoff that you've calculated here in the 6,370,998 tons? 02:14PM
A I don't know because I didn't conduct that investigation.
Q Is it generally true, sir, that the phosphorus that would be contained in the upper, say, two inches of the highest horizon of the soil would be more susceptible to runoff than something that's a meter below ground surface? 02:14PM
A I wouldn't put a number to it of two to four or two to six inches, but I would agree that phosphorus that is closer to the surface is more likely to run off than phosphorus at deeper layers. 02:14PM
Q Your analysis included even the deeper layers, did it not? 02:14PM

Page 154

A I don't know. I would -- to answer that question, I would have to read this paper, critically review it and attempt to understand exactly what was done, and then I would form my own opinion about whether this work was credible and so forth before I could express any opinion about any individual sentence or anything in the document. 02:33PM

Q Are you familiar with the Journal of Environmental Planning & Management where this paper was published? 02:34PM

A Yes. I've read articles from that journal.

Q Is it a peer-reviewed publication?

A Yes, it is.

Q Can we turn to Page 4 of your report, sir?

A I'm there. 02:34PM

Q Would you read the supporting statement 1B, please?

A The GLEAMS model used by Dr. Engel is an inappropriate tool for predicting watershed scale non-point source phosphorus loads to streams and rivers in the IRW. 02:34PM

Q Okay. Would you explain what you mean by that statement, sir?

A Pages 4, 5 and the top of 6 explain what I mean by that statement. So I'm not sure what 02:35PM

Page 155

additional information you're seeking.

Q What about the GLEAMS model is inappropriate for predicting watershed scale non-point source phosphorus?

A Well, it's inappropriate for the reasons that I begin to state. Beginning with the second paragraph on Page 4, Shoemaker, et al, 2005, state the following limitations: Limited to an agricultural field of very small size not suited for bigger watersheds, not suited for urban land uses. 02:35PM 02:36PM

Q Okay. I believe you've testified, sir, that this particular work in this case was your first experience working with the GLEAMS model?

A That's correct.

Q And then I believe your testimony has been that you personally have had limited experience with upland water quality runoff models? 02:36PM

MR. BOND: Object to form.

A That's correct. Let me continue my answer, sir. For 35 years I have developed, applied, used and reviewed deterministic process-based mass balance models. Those models have -- they balance water; they balance mass. Those scientific principles -- those identical scientific principles embodied in field scale runoff models such as 02:36PM 02:37PM

Page 156

GLEAMS, watershed scale models such as HSPF and SWAT, receiving water models such as CE-QUAL-W2, CE-QUAL-ICM, WASP, BFDC and so on. Those are all process-based finite volume mass balance models. They balance mass; they balance water. I've spent 35 years at my career doing that. I know a mass balance model when I see it. 02:37PM

Number two, this is an EPA agency report. I have no reason to disbelieve any of the conditions for applicability that I read in Shoemaker, et al, 2005, or any of the other references I've cited therein in my report. 02:37PM

Q Sir, would you -- would you -- are you suggesting that the data that you input in a runoff model, field runoff model is similar to the data you use in an in-stream model? 02:38PM

A No, that's not what I'm saying. I'm saying I know what a mass balance model looks like when I see it, and GLEAMS is a mass balance model, and every model has a -- is specifically designed to operate at certain spatial scales at certain time scales and include certain physical chemical and biological processes. 02:38PM

Q Okay. Are the coefficients that are employed in the GLEAMS model similar to the CE-QUAL model 02:38PM

Page 157

that you mentioned?

A They're similar in that both models have loads. Both models represent physical, chemical and biological processes.

Q But they're different processes, are they not, sir? 02:39PM

A It depends on the level of physical, chemical or biological resolution you want to go to. They are fundamentally mass balance models.

Q But the coefficients that are used to run off -- to determine runoff from land are different coefficients and processes than determine what happens to, let's say, phosphorus in the stream, are they not? 02:39PM

A Some of the coefficients are different. They still represent sources, transport, fate, transformation and attenuation of phosphorus through the environment. The models are -- the science is identical in that respect. 02:39PM

Q But the phosphorus put on a field is different than fate -- the processes affecting phosphorus on a field are different than the processes affecting phosphorus in the water column. Do you agree with that, sir? 02:39PM

A Not completely. Some of them are identical, 02:39PM

Page 158

such as phase partitioning and precipitation.
Q Are most of them different?
A I wouldn't say most. Some of them are different.
Q Which ones are different? 02:40PM
A If a molecule of phosphorus is attached to a soil particle in a field and if precipitation occurs and if other conditions are met, such as the cohesiveness, the intensity, frequency, duration of rainfall and so on, a potential consequence is that 02:40PM that soil particle can move, and if it moves far enough, it will leave the field and enter a receiving water body. That sequence of steps I just described happens in a field. It doesn't happen in the water column of Lake Tenkiller. 02:40PM
Q Any other differences?
A Well, there probably are. Again, it depends on the level of detail. I guess that to me there are more similarities than difference because they are finite element process-based mass balance 02:41PM models.
Q Was the GLEAMS model used by itself to model the watershed?
A Dr. Engel used the GLEAMS model by itself to compute phosphorus loadings to edge of field. He 02:41PM

Page 159

then, using independent information, added wastewater treatment plant phosphorus loads to those edge of field loads to compute the total load to the river and stream system for each of the three subwatersheds in the Illinois River basin. He then 02:41PM used what he called a writing model to -- we use the route is his word that phosphorus to the USGS stations at Tahlequah, Baron Fork and Caney Creek.
Q Have you ever used an empirical model?
A Yes. 02:42PM
Q Have you ever used an empirical routing model?
A I wouldn't use the term empirical routing model. That's Dr. Engel's description of the model he developed. That is not a commonly-accepted term that has general meaning in the environmental 02:42PM modeling community. I've used empirical. I've used LOADEST. That's a statistical model. In fact, I believe in Dr. Engel's expert report he draws a parallel, a comparison between the LOADEST statistical model and his routing model. 02:42PM
Q Have you used empirical equations for routing in your modeling work?
A I don't recall using empirical routing equations in the way that Dr. Engel has used empirical routing equations. Dr. Engel -- my 02:43PM

Page 160

understanding of what --
Q That answers my question, sir. If you don't recall doing it, that's good. Thank you.
MR. BOND: Did you want to explain further?
A Well, I would like to explain further. 02:43PM
MR. PAGE: Well, then you can ask him a question on cross examination. He answered my question.
VIDEOGRAPHER: Can we stop for a second? I think something just happened. All my system just shut down.
MS. LLOYD: I lost power, too.
MR. PAGE: Let's go off the Record.
(Whereupon, a discussion was held off the Record.) 02:44PM
VIDEOGRAPHER: We are now back on the Record. The time is 2:45 p.m.
Q Okay. Dr. Bierman, does the SWAT model use the same nutrient runoff criteria back -- as the GLEAMS model, that is, did the SWAT model borrow the 02:45PM GLEAMS nutrient runoff analysis for its model?
A I know that the science underlying GLEAMS is the same as the science underlying SWAT, but whether or not the specific runoff, was it a coefficient or process that you referred to is the same as GLEAMS, 02:45PM

Page 161

sitting here now I don't know that.
Q Does SWAT add to those runoff coefficients that uses a routing method?
A My understanding of SWAT is that it is a watershed model, not a field scale model. So, 02:45PM therefore, it contains in the modeling framework a -- I won't call it a routing model it but it contains -- it explicitly represents the stream delivery.
Q Have you worked with a SWAT model before? 02:46PM
A No, I've not.
Q Are you familiar with the ADAPT, A-D-A-P-T, model?
A No, I'm not.
Q Are you familiar with EPIC, E-P-I-C, model? 02:46PM
A Vaguely.
Q Do you know what kind of a model it is?
A It's a runoff model of some type.
Q And does it add to it a routing component so it can be used on a watershed scale? 02:46PM
A I don't know.
Q Does the SWAT model to your knowledge, sir, use the HRU concept?
A I don't -- based upon my review of the SWAT model applied to the Illinois River watershed by Dr. 02:46PM

Page 166

be any larger. There were 50 HRUs in Dr. Elm -- excuse me, Dr. Engel's GLEAMS model. I believe there were 22 in the Illinois River basin, river subbasin, 20 in Baron Fork and 9 in Caney Creek, 39. The areas for 39 of those HRUs were in excess of 02:53PM 1,000 acres. 78 percent of the HRUs were much larger in order of magnitude or more larger than the guidance provided in the CREAMS manual for how big is a field.

Q Is that guidance carried over in the GLEAMS 02:54PM manual?

A I don't know.

Q Are you aware of published peer-reviewed reports where the GLEAMS model was used in conjunction with some type of a routing method to 02:54PM evaluate a watershed size phosphorus loadings?

A I'm aware of one or two of the GLEAMS applications conducted by Dr. Engel in Indiana watersheds, but I can't recall, sitting here, if they involved any routing models. 02:54PM

Q In the examples that Dr. -- that you looked at for Dr. Engel, did he apply in his peer-reviewed published article the GLEAMS model to be on field scale, that is, to a watershed size analysis?

A I can't recall what the watershed scale -- I 02:55PM

Page 167

can't recall what the scales were in detail.

Q Let me hand you what's marked as Exhibit No. 6. Can you identify that document for the Record, please, sir?

A Yes. It's a paper that was published in 02:56PM Biosystems Engineering in 2008. The title of the paper is Phosphorus Export From Agricultural Land: A Simple Approach. The principal author is A. Leone.

Q Are you familiar with this article, sir? 02:56PM

A I don't believe I've seen it. No, I'm not familiar with it.

Q Are you familiar with the journal?

A I've heard the name but I'm not familiar with the journal. 02:56PM

Q On the abstract, sir -- I don't know if it's the abstract, but the first page, the second paragraph about halfway down, it says the Lake Vico basin in central Italy. Do you see that, sir?

A Yes. 02:56PM

Q Would you read that to give us some background as to the work done in this case?

A Well, I can read it. I'm not sure if it provides background for this case.

Q Would you read it out loud? 02:56PM

Page 168

A Yes. The Lake Vico basin in central Italy was selected as a suitable site since the P concentration of the lake increased dramatically at the beginning of the 1990s due to P non-point pollution source loads. 02:57PM

Q Continue, please.

A The GLEAMS, the simulation model, in paren, groundwater leaching effects of agricultural management systems, GLEAMS, closed paren, was used to evaluate field scale P losses in two different 02:57PM scenarios, conventional and conservative agricultural practices. A regression model for each of these two scenarios was then fitted to find the best relationship between slope on the one hand and P losses. This regression allowed the GLEAMS 02:57PM results to be extended to basin scale by a digital terrain model and a geographic information system, open paren, GIS, closed paren, making it possible to evaluate P export into the lake, thus, meeting management needs. 02:58PM

Q So how was GLEAMS used by these investigators to evaluate a watershed scale runoff of P?

MR. BOND: Objection to the form.

A I can't answer that question because I haven't read the paper. I just read what you asked me to 02:58PM

Page 169

read into the Record. That's all I know about it.

Q Does what you just read indicate that they combined GLEAMS with a regression model and GIS analysis in order to do a watershed scale size evaluation of phosphorus loads to water? 02:58PM

MR. BOND: Object to the form.

A All I know is what they said they did. I don't know exactly what they did. I would have to review the paper and investigate it in detail and form my own opinion about what they did and whether 02:58PM it has any scientific validity. I should also say that if I were asked to conduct a review of this paper, I would not only review what the authors did versus what they say they did, but I would also point out that what they did here may or may not be 02:59PM relevant to Dr. Engel's coupled GLEAMS and routing model for the Illinois River watershed.

Q Did you do any investigation, sir, as part of your work in this case to determine whether GLEAMS model has been used on a watershed scale? 02:59PM

A I reviewed -- I read a number of papers on GLEAMS applications, and my recollection is that I know that Dr. Engel applied it to a couple of watersheds in Indiana that I believe were on the order of a thousand or 2,000 acres. It might have 02:59PM

Page 170

been hectares. I don't recall.
Q Those were published applications?
A I believe so, one paper. There was two, two applications on one paper. I can't recall, sitting here right now, if GLEAMS -- again, we need to define watershed scale. We're talking about a million acres here. A million acres is much larger than 2,000 acres or a thousand acres. 03:00PM
Q And how would that make a difference?
A GLEAMS itself computes runoff to edge of field, and it's designed -- I think we have the issue of context here. Nowhere in my expert report do I take issue with the GLEAMS model itself. Everything has context. This report, my expert report and the opinions expressed therein are directed towards the site-specific application of the GLEAMS model by Dr. Engel to the Illinois River watershed. 03:00PM
Q Okay. I'm just asking you, sir, whether you did an investigation to see whether the GLEAMS model has been applied, other than what you mentioned looking at Dr. Engel's -- let me strike that. Other than the cases where you looked at Dr. Engel's publications where he applied the GLEAMS model to the watersheds rather than just to a clear field, 03:01PM

Page 171

did you investigate whether other scientists have used the GLEAMS model and applied it to a watershed scale analysis?
A For purposes of computing loadings to a receiving water body or simply applying it to a large field and -- 03:01PM
Q To -- for loading --
MR. BOND: He's trying to answer.
A -- using it to computer runoff --
Q I think you asked him a clarification question, and I'm saying for the purposes of computing loadings to a watershed body, water body in a watershed. 03:01PM
A I read a number of papers about GLEAMS applications. I don't recall, sitting here, reading a paper describing the application of GLEAMS to a watershed on the order of one million acres for the purpose of, one, quantifying the loadings of phosphorus to a receiving water body and, two, determining the relative contribution of any individual sources to those phosphorus loads, and that's what Dr. Engel did. 03:02PM
Q Okay, but you did not happen to review the Leone papers prior to your analysis; correct?
A No, I did not. 03:02PM

Page 172

Q Okay. Let's turn to Page 273 of the Leone paper. Under Section 2.1, do you see that, sir?
A Yes.
Q The second paragraph where it says the model takes into consideration, I want you to read that and tell me whether or not you agree with this author's characterization of GLEAMS. If you read it out for the Record, sir, then that's my question. 03:03PM
A The model takes into consideration four major components: Hydrology, erosion, pesticides and nutrients. I agree with that. 03:03PM
Q Okay.
A It's designed to do exactly that.
Q Continue.
A Regarding P, GLEAMS simulates mineralization and mobilization, fertilizer and animal waste application and, furthermore, crop uptake, together with runoff, sediment and leaching losses, are considered. I agree with that as well. 03:03PM
Q Is it your understanding that GLEAMS does a good job with those processes? 03:03PM
MR. BOND: Object to the form.
A I have no opinion on whether GLEAMS does a good job with those processes. The only way I would ever express an opinion -- strike that. The next 03:04PM

Page 173

sentence, it allows the effects of agricultural management systems to be evaluated within and throughout the plant root zone, considering the consequences of management and natural inputs and their influence on hydrology, erosion and chemical processes both on the soil surface and within the soil profile. 03:04PM
Q Do you agree with that, sir?
MR. BOND: Object to the form.
A I have no opinion on that sentence, and here's why: Because the previous sentences were fact-based statements as to the capabilities of GLEAMS. This sentence here, it -- these are not fact-based descriptions of GLEAMS capabilities. It's a statement by the author of what -- of their opinion of what GLEAMS allows, and I will not sit here and agree or disagree with that opinion unless I read this paper and thoroughly investigate it. 03:04PM
Q Okay. Let's look over to the second column on 273, sir. 03:05PM
A Uh-huh.
Q It identifies some formula, and then on the fourth sentence down it says, these simple formula. Would you read that for the Record, sir?
A These simple formula also allow GLEAMS results 03:05PM

Page 194

which each component does and how they're linked. I just know what I've read.
Q Are you familiar with the Manning's equation?
A Yes.
Q Okay. What is that? 03:48PM
A In simple terms, water flows downhill, and if one knows the size and shape of the channel and a friction coefficient, one can use it to estimate velocity of the water flow.
Q So is that the routing equation that was used 03:48PM in this particular watershed analysis?
A Well, it says that's what they did. Again, I just know what I read. I've not read the entire paper; I've not reviewed the paper.
Q On Page 5, sir -- 03:49PM
A Of my expert report?
Q Yes. Thank you, Dr. Bierman. The third paragraph --
A Yes.
Q -- you are talking about the total area of the 03:49PM IRW?
A Yes.
Q And you mention the HRUs, correct, in that paragraph?
A Yes. 03:49PM

Page 195

Q And the statements there says, these areas, I guess referring to the HRUs, are much too large to accurately represent local conditions that influence non-point source runoff of phosphorus to edges of individual fields. Did I read that correctly, sir? 03:50PM
A Yes.
Q Okay. What did you do to determine whether or not the HRUs, as selected by Dr. Engel, were too large to accurately represent local conditions?
A One thing I did was to reference Figure 1, 03:50PM which shows that the sediment delivery within a 99,148-acre drainage area could range over approximately a factor of four. What that means is that a phosphorus delivery from a field that large to edge of field depends on the location of the 03:51PM phosphorus. If it's in the middle of the field versus near the edge, the runoff coefficient and, hence, the probability that that phosphorus will run off to the edge of field is very different depending on the location in the field. 03:51PM
In Dr. Engel's model with his HRUs, a pound of phosphorus eroded from the middle of his 99,140-acre pastureland has the same probability of delivery to a stream or river as a pound of phosphorus eroded from near the edge. This is not physically 03:51PM

Page 196

realistic.
Q Did you do any evaluation to determine if your concern actually did have an impact on the accuracy of the IRW model prepared by Dr. Engel?
A No, it wasn't my job to correct or redo Dr. 03:52PM Engel's work. It was my job to review it and criticize it.
Q Why is sediment delivery important to this phosphorus model that Dr. Engel put together?
A Because it's -- phosphorus sticks to things. 03:52PM It's well known that phosphorus sticks to solids. If a precipitation event occurs and mobilizes solids and solids are eroded, the phosphorus goes with it. So sediment transport and phosphorus transport are very tightly coupled. 03:52PM
Q Did you review any of the actual data in this case to determine what portion of the phosphorus leaving land-applied fields is associated with sediments as opposed to dissolved phase?
A No, I don't. 03:53PM
Q So you don't know exactly how important sediment delivery is for phosphorus in this watershed, do you?
MR. BOND: Object to form.
A I disagree with that, and I'll explain why I 03:53PM

Page 197

disagree with it. I didn't personally conduct such investigations, but other investigators have done so. So on Page 23 of my expert report, for example, I reference a USGS report by Terrio, 2006 entitled Concentrations, Fluxes and Yields of Nitrogen, 03:54PM Phosphorus and Suspended Sediment in the Illinois River Basin 1996 through 2000, and I've excerpted a statement from that report on Page 7, which states that phosphorus is generally transported to surface water bodies through overland runoff and in 03:55PM association with sediment particles and that many elements and compounds, including some forms of nitrogen and phosphorus, absorb to sediment particles and are transported and deposited with the sediment. On Page 38 it goes on to state that the 03:55PM general correspondence between suspended sediment flux and stream flow is expected in most watersheds and particularly in those with agricultural areas where sediment is transported through overland runoff, bank erosion and the resuspension of benthic 03:55PM sediments during periods of precipitation and increased stream velocity. So this was taken from a report on the specific site by a USGS investigator. That is part of my basis for making the statement.
Q What specific site? 03:55PM

Page 198

A In the Illinois River basin.
Q Is that the same Illinois River basin that's being investigated in this case?
A Check that. I might have mistaken. I might have mistaken whether this was site specific to this Illinois River basin. 03:56PM
Q In fact, this study by Terrio was of the Illinois River in Illinois; isn't that correct?
A If that's the case, then I made an error, and I stand corrected, but it doesn't change the science. It doesn't change anything Terrio said. In fact, the evaluation -- on Page 23 of my expert report, I state that sediment is important because it transports phosphorus from overland runoff, stream bank erosion and resuspension through the stream and river network of the IRW into Lake Tenkiller. 03:56PM 03:57PM
Q Okay. Did you do any -- do you have any review of any reports or review any site-specific data to the Illinois River basin in Oklahoma and Arkansas that would give you some indication of the importance of sediment transport of phosphorus in the basin under consideration in this case? 03:57PM
A There's another site-specific reference in my expert report, which I can't locate at the moment, 03:57PM

Page 199

which makes the same point.
Q Another one, you mean --
A There is a site-specific reference, which I can take the time to locate it. I don't recall where it is at the moment. 03:58PM
Q Okay.
A That doesn't change the fact that the science of adsorption of phosphorus to solids is well known, and Dr. Engel himself has stated on Page 1231 of his own paper entitled a Hydrologic/Water Quality Model Application Protocol that was published in the Journal of American Water Resources Association in October of 2007. Dr. Engel was a senior author. On Page 1231 of this paper he states in reference to hydrologic water quality models, that the model is typically calibrated first to obtain acceptable performance in the hydrologic components, then for sediment and finally for nutrients, pesticides, bacteria and other constituents. 03:58PM 03:58PM
Q Okay. Dr. Bierman, are you suggesting that the processes in the Illinois River basin that relate to runoff would apply -- the same process would apply in the Illinois River basin as are found in other watersheds across the United States? 03:59PM
A I'm saying that the science of phosphorus 03:59PM

Page 200

adsorption to solids doesn't change from site to site, in that phosphorus adsorbs to solids in the Illinois River basin in Arkansas, in any other Illinois River basin, and in river basins in general phosphorus adsorbs to solids and it's well known that the two co-transport. 03:59PM
Q And are you also of the opinion that that phosphorus that adsorbs to solids also runs off from the Illinois River basin fields as it does in other fields across the United States? 04:00PM
A I would not make such a blanket statement. These things are site specific. The science is the same. The site-specific conditions are different. The relationship between runoff -- the relationship between precipitation and runoff of solids and the associated phosphorus in the Illinois River basin are not necessarily the same as the relationship in other basins, but the relationship is there; it is strong; it is universal, and that's a well-accepted fact. 04:00PM 04:00PM
Q And you assume, sir, I guess to support your statements on Page 5, that sediment does run off of fields in the Illinois River basin that has phosphorus attached to it, do you not?
MR. BOND: Object to the form. 04:00PM

Page 201

A Yes, because if sediment runs off of an agricultural field -- if only because phosphorus is a natural element and it's contained in soil, if soil runs off, phosphorus runs off.
Q Do you have any reason to believe that soil does not run off of fields within the IRW? 04:01PM
MR. BOND: Object to the form.
A Whether soil runs off of a given field in a given location for a given precipitation event depends on site-specific conditions. It doesn't necessarily run off for every event. It depends on the frequency, intensity and duration of runoff, and it must be sufficient to cause mobilization of the solids. 04:01PM
Q Do you agree, sir, that given sufficient rainfall or precipitation, that poultry waste will run off from land-applied fields in the IRW? 04:01PM
MR. BOND: Object to the form.
A I'm sorry. Please repeat the question.
(Whereupon, the court reporter read back the previous question.) 04:02PM
MR. BOND: Same objection.
A I would agree with an additional qualification. It doesn't depend just on rainfall. It also depends on conditions of the site, the soil, 04:02PM

Page 226

A I think the time period -- I think the time period included the first few years of Dr. Engel's period of application for actual conditions, that is, I think the time period included perhaps '97, '98, maybe '99. 04:48PM

Q Okay. When it says -- when the delivery ratio says 60 to 70 percent is delivered, does that mean the other 30 to 40 percent is forever lost in the system or does it just mean it's delayed and it eventually will be delivered? 04:48PM

A Could mean both. All it means is that during the period of simulation for the conditions that occurred during that simulation, some of it made it and some didn't. So where did it go? Well, at least during the period of simulation, the model 04:48PM would indicate that it would be held in the sediments. At the one extreme a very large event could occur. A large precipitation, flow and resuspension event could occur and wash much of that down in one slug, or over a long period of time 04:49PM perhaps the cumulative impact of numerous events would eventually move part of it to the lake.

Q Do you know whether or not the climate and other characteristics of the IRW indicates that there's major flushing events on a regular basis? 04:49PM

Page 227

MR. BOND: Object to the form.

A I don't know because I haven't investigated that.

Q Did you calibrate the HSPF land uses at the edge of field? 04:49PM

A No, we didn't do any calibration. We simply took the AQUA TERRA work products and did some simulations with it.

Q Did they do that calibration in their work?

A They recalibrated the model. They used -- I 04:49PM don't recall the details of their recalibration.

Q Did they calibrate the edge of field?

A I can't recall. I should say it's not -- we should not really call it the AQUA TERRA model. AQUA TERRA was asked to recalibrate it. The model 04:50PM was originally developed by Tetra Tech, and as I understand the scope of work for AQUA TERRA, they were just told to, in my words, repair it, improve it, fix it, bring it up to date, recalibrate it. They were not asked to actually rebuild it. 04:50PM

Q Do you know whether Tetra Tech calibrated the model to edge of fields?

A I don't know what -- no, I don't know. I should say that how one calibrates a model is a function that directly depends on the objectives of 04:50PM

Page 228

the modeling effort. My understanding of the objective of the Tetra Tech effort and the TMDL effort -- strike that. My understanding of that effort was it was designed to compute the total loadings to Lake Tenkiller and to break them down 04:51PM into whatever land use categories were included in the model, and my recollection is that one of them was not poultry litter P. That was not the purpose of that study.

Q But was the purpose of the study to determine 04:51PM non-point source contributions?

A I don't actually know what the purpose of the study was. Well, I do know that one purpose of it was to determine total P loadings to Lake Tenkiller. If there were other specific purposes, I'm not sure 04:51PM what they were because I didn't see the work plan and I don't recall reading the original Tetra Tech report.

Q Was it for a TMDL?

A The purported use was for a TMDL. 04:52PM

Q In your experience don't TMDLs attempt to allocate a portion of the nutrients to non-point sources?

A That's correct.

Q Well, you don't know whether they were trying 04:52PM

Page 229

to do that in this case?

A They probably were, but I don't -- I don't know in detail what their objectives were. I'll put it this way: If they didn't care about non-point sources, they would not be using a watershed model. 04:52PM They would have -- they might have just saved a lot of money and effort and piped in the wastewater treatment plant loadings, assumed 100 percent delivery and just did it quick and dirty.

Q Would you look at Page 5 of your report, 04:52PM please?

A Yes.

Q On the next to the last paragraph it says, still another limitation.

A Yes. 04:52PM

Q Would you read that for the Record, that short paragraph?

A Still another limitation is that GLEAMS is an agricultural model and was not designed to represent urban land. This is important because urban land 04:53PM has impervious areas, in paren, that is, roads and pavement, closed paren, and GLEAMS does not have the capability to represent impervious land uses.

Q Has GLEAMS been applied to urban landscapes that include impervious lands? 04:53PM

Page 230

A Dr. Engel did so.
Q Have other people used it in that fashion?
A I don't know. That statement is based on the Shoemaker, et al, report, and it's based on -- well, based on the GLEAMS manual itself, the stated purpose is that it's a model designed to simulate agricultural fields of very small size. That's not urban land area. 04:53PM
Q Well, you don't know whether or not other investigators have used GLEAMS for urban runoff? 04:53PM
A No, and if they did so, they misused it in contravention to the stated purpose in the manual and to the guidance in Shoemaker, et al.
Q Based on those two sources, but you personally have not used GLEAMS before this particular case; is that correct, sir? 04:54PM
A I have not used it, but that doesn't mean that I don't know that it's not designed for urban land use.
Q Okay. What work have you done evaluating, personally evaluating runoff from urban lands? 04:54PM
A The HSPF model for the Chesapeake Bay watershed involves urban land areas, direct drainage, combined sewer overflows. The HSPF base model for the bacteria TMDL for the North Buffalo 04:54PM

Page 231

Creek in the city of Greensboro involved many different land areas. In fact, that was a highly urban area.
Q Do you know whether or not the coefficients for HSPF for urban are the same coefficients that are employed in the GLEAMS model? 04:55PM
A Well, they can't be because GLEAMS is not designed to represent urban areas.
Q Have you ever evaluated what coefficients are used in the HSPF model for urban runoff? 04:55PM
A I did in the -- at different points in time I've looked at the HSPF model for the Chesapeake Bay watershed. I evaluated the HSPF coefficient for the different land uses in the Caloosahatchee estuary, one of which was urban. 04:55PM
Q Do you know whether or not GLEAMS can be modified to include urban uses?
A An experienced modeler can make modifications to a model and can add capabilities for it to do something for which it might not have originally been designed. In that broad general sense, GLEAMS is no different than HSPF, WASP, whatever. They are usually site specific -- there are frequently site-specific modifications that are made in the applications of models. 04:56PM

Page 232

Q Can I ask you this then, sir: Have you personally, other than the HSPF applications to urban runoff, have you ever personally done any investigations of the factors that relate to urban runoff of nutrients? 04:56PM
MR. BOND: Object to the form.
A Have I conducted experiments?
Q Yes, sir.
A No, I've not conducted experiments. What I have done is I've looked at the 1NU.par nutrient parameter input file for Dr. GLEAMS (sic) model application to the Illinois River watershed, and that contains a parameter that indicates Crop Type No. 2, which corresponds to alfalfa hay, and that's in the GLEAMS manual. 04:57PM
Q Okay.
A And alfalfa hay on pastureland does not represent urban land use area in the Illinois River watershed, and all I know is that that's how Dr. Engel applied that model to that land use. 04:57PM
Q Is it your testimony, sir, that Dr. Engel used alfalfa hay as the urban -- as a surrogate for urban runoff?
A No, that's not what I said. I'm saying that the plant nutrient input file for the urban land use 04:57PM

Page 233

in Dr. Engel's model specifies alfalfa hay as a crop type. It specifies other parameters as well.
Q Have you done any evaluation of the relationship between the nutrients from a field where alfalfa is grown as compared to an urban land use? 04:58PM
A No, I've not. One generally would not represent urban pavement as an alfalfa hay field.
Q Well, unless you did some study to indicate there's an equivalent on the runoff; correct, sir? 04:58PM
A I don't think I need a study to tell me that I shouldn't represent the parking lot at Wal-Mart in Fayetteville as a field which grows alfalfa and hay, sir.
Q But you haven't done any analysis to see if there's a difference between a runoff on a Wal-Mart parking lot as to nutrients and that of an alfalfa field, have you, sir? 04:58PM
MR. BOND: Object to the form.
A That is correct. 04:58PM
Q Let me hand you what's been marked as Exhibit 10 and if you'd please review that and identify it for the Record, sir.
A This is a paper published in the transactions of the ASABE in 2007. It's entitled The Soil and 05:00PM

Page 234

Water Assessment Tool: Historical Development, Applications and Future Research Directions, and it's senior authored by P. C. Gassman, G-A-S-S-M-A-N.

Q Is it your understanding that SWAT uses the GLEAMS and CREAMS runoff components for its model? 05:00PM

A I'm sure some of the detailed components are different, but as Dr. Engel stated in his deposition, the science underlying SWAT is the same as the science which underlies GLEAMS. 05:00PM

Q And do you know whether or not GLEAMS had any special component for urban runoff -- excuse me, not GLEAMS, but SWAT had any special component in addition to what it obtained from CREAMS and GLEAMS to model urban runoff? 05:01PM

A I don't know.

Q Is SWAT used for urban runoff?

A Dan Storm in his application of SWAT to the Illinois River watershed included urban land use, so I know he applied it to urban land use. 05:01PM

Q Do you know whether or not it is typically applied to urban runoff, that is, SWAT?

A I don't know that for a fact.

Q Have you ever reviewed Exhibit No. 10?

A No, I have not. 05:01PM

Page 235

Q I assume, sir, when I asked you whether you performed any scientific investigations relating to urban runoff, you also haven't published any peer-reviewed papers relating to nutrient contributions from urban runoff, have you, sir? 05:02PM

A I've not published any papers specifically directed at urban runoff, no. I've published modeling papers in which the -- strike that. That's -- I'll stay with that answer to your question. 05:02PM

Q Let's turn to Page 6 of your report, Dr. Bierman.

A I'm sorry, what page?

Q Excuse me. Page 6.

A Oh, of my report. Sorry. 05:03PM

Q Yes, of your report, sir, Exhibit 1 to the deposition.

A Yes, here we go.

Q Would you read supporting statement 1C that's located on that? 05:03PM

A Yes. The phosphorus routing model developed by Dr. Engel is not a valid representation of the real system of streams and rivers in the IRW and is an inappropriate tool for predicting delivery of phosphorus loads to Lake Tenkiller. 05:03PM

Page 236

Q Okay. Did you perform any tests or analysis to demonstrate the truth of that statement?

A Actually I did. The results of those tests are included under Opinion 3, supporting statement A in my expert report. 05:04PM

Q Okay. Did you -- that's where you changed the loadings using different loadings; correct?

A Yes. I used different inputs. I used different non-point source loadings, different wastewater treatment plant loadings. We reversed 05:04PM the order of the loadings, time order of the loadings, and we also specified the S and P stock index values as P to river.

Q Did you do anything else other than that test, sir? 05:05PM

A I can only recall the tasks that are in supporting statement 3A. I think I mentioned them all, but I'm not sure.

Q Did you actually do any sensitivity analysis that indicated that the routing model employed by 05:05PM Dr. Engel did not accurately represent the routing and delivery of phosphorus to rivers and streams in the IRW?

A I have to make some assumptions to answer your question. First of all, Dr. Engel's routing model 05:06PM

Page 237

in my opinion doesn't actually route anything, and he stated in his deposition that it merely is a time distributor for loads. So I think the routing model -- the term routing -- I know it has to be called something. It doesn't actually route anything. 05:06PM

Q But what I'd like you to do is answer my question.

A I'm sorry.

Q And that is, did you do anything to determine whether or not the model that Dr. Engel used, the 05:06PM routing model that he used --

A Yes.

Q -- in fact did not represent a valid representation other than what you did about Question 3A? 05:06PM

A Okay.

Q For example, did you use like CE-QUAL in-stream model to see if it produced different results?

A No. My contention here in statement 1C is 05:07PM that the routing model is not a representation of the real system of streams and rivers. I don't need to apply an alternate model to form that opinion.

Q Okay. What -- what in your opinion would be an appropriate model that would show a, quote, real 05:07PM

Page 238

representation of what's happening in rivers and streams in the IRW?
A It depends on how much detail one wants to include. There is no single correct answer to your question, but I will provide an answer. The -- a model that's a valid representation of the real system would include phosphorus in both the water column and sediments. There was no sediment compartment in Dr. Engel's model. 05:07PM
Q Okay. Did you run any kind of analysis using those constituents to see whether the result was different than what Dr. Engel used in his routing model? 05:08PM
A No. As I stated, my supporting statement 1C expresses the opinion that it isn't a valid representation of the real system of streams and rivers. 05:08PM
Q But you didn't try a better representation to see if it would get a different result, did you?
A A different result for what? 05:08PM
Q The routing of the phosphorus from the edge of the fields to Lake Tenkiller.
A Well, it didn't actually route anything. So are you referring to the comparisons between the predictions of what we are calling the routing model 05:08PM

Page 239

and the -- Dr. Engel's observed loads to Lake Tenkiller?
Q If that helps you answer the question, yes, sir.
A I did not apply or run an alternate model. 05:09PM
Q Okay. On this --
A Excuse me. Except, again just so the Record is clear, we ran some simulations with the HSPF model, some screening simulations, but we -- that's the full extent to which I utilized an alternate approach, and the purpose there was just to better understand the system and to compute the watershed delivery. 05:09PM
Q Did you compare those screening simulations with HSPF to Dr. Engel's results for loadings? 05:09PM
A Not in a systematic way. We looked at the HSPF loads. We looked at the loads from Dr. Engel's routing model. We didn't do a formal comparison.
Q What did your informal analysis show you?
A I actually can't recall how the HSPF loads compared to Dr. Engel's loads. There were some differences. You never get exact numbers. One reason why we couldn't compare them exactly is because the two models represented different periods of time and, hence, different conditions of 05:10PM

Page 240

precipitation and so on. So an exact comparison was not possible.
Q So why did you stop your analysis with HSPF model; why didn't you continue with that and develop it for the IRW? 05:10PM
A Well, my assignment was to review Dr. Engel's body of work and to prepare an expert report on his body of work, not to correct the deficiencies in his model, not to do his work over or not to apply an alternate approach. 05:11PM
Q Isn't one method of review is to try to do the same analysis with a different approach to see if you get similar or different results? That's a method of review, is it not?
A It could be one method. Actually the criticisms and deficiencies in the errors that I identified in Dr. Elm -- Dr. Engel's -- excuse me, Dr. Engel -- Dr. Engel's GLEAMS model and routing model are demonstrable and stand on their own. They don't require me or anyone else to develop an independent parallel modeling framework to compare the results. 05:11PM
Q Is Dr. Engel's routing model based on empirical, that is, observed data?
A His routing model uses empirical data for USGS 05:11PM

Page 241

flows, and it uses computed loads to Lake Tenkiller and the outputs and his P to river results from the GLEAMS, plus the WWTP loads.
Q So his routing equation used actual data taken from the IRW? 05:12PM
A Parts of it do, yes.
Q Are you familiar with LOADEST, sir?
A Yes.
Q What is LOADEST?
A It's a package of statistical routines. I think there are eight or nine or perhaps a dozen different routines, and the purpose of the program -- it's a tributary load estimation program. The inputs would be measured flows and measured concentrations. LOADEST then uses different methods to develop relationships between measured flow and measured concentration so that it can estimate concentration on days when flow is measured but for which there is not a measurement of concentration, and then it computes mass loading time series. 05:12PM 05:13PM
Q Is it based on observed data?
A Yes.
Q Does LOADEST use a similar form of equation as Dr. Engel's routing equation in calculating modes?
A I don't think there is a -- I don't think any 05:13PM

IN THE UNITED STATES DISTRICT COURT FOR THE
NORTHERN DISTRICT OF OKLAHOMA

W. A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA and OKLAHOMA SECRETARY OF THE ENVIRONMENT C. MILES TOLBERT, in his capacity as the TRUSTEE FOR NATURAL RESOURCES FOR THE STATE OF OKLAHOMA,	)
Plaintiff,	)
vs.	) 4:05-CV-00329-TCK-SAJ
TYSON FOODS, INC., et al,	)
Defendants.	)

- -

VOLUME II OF THE VIDEOTAPED DEPOSITION OF VICTOR BIERMAN, PhD, produced as a witness on behalf of the Plaintiff in the above styled and numbered cause, taken on the 15th day of April, 2009, in the City of Tulsa, County of Tulsa, State of Oklahoma, before me, Lisa A. Steinmeyer, a Certified Shorthand Reporter, duly certified under and by virtue of the laws of the State of Oklahoma.

phosphorus, was it not?
A No, I don't agree with that. They wanted a screening level tool to assess fate and transport of nutrients under restoration scenarios that had been proposed. 09:56AM
Q Do you know how the South Florida Water Management District used the scale that's described in Exhibit 13?
A No, I don't, but I know what they told us they wanted, and they wanted a screening tool so that 09:56AM they could assess restoration scenarios. It's a screening tool.
Q So you don't know whether or not it was used to make policy decisions or regulatory decisions?
A I don't know exactly how it was used, but I 09:56AM know it was not used to support litigation.
Q Do you show here on Figure 3 a standard error?
A No, I don't.
Q Were all those calculations made as part of your calibration process for this model, that is, 09:56AM one-to-one R-squared and standard error?
A I can't recall. It was ten years ago.
Q I don't recall whether I asked you this earlier. If I have, I apologize, Dr. Bierman, but did you quantify how important urban phosphorus 09:57AM

runoff was to phosphorus loads in the IRW water basins?
MR. BOND: Object to the form.
A Did I quantify --
Q Yeah. 09:57AM
A -- how important? No, I did not.
Q Let me hand you what I've marked as Bierman Exhibit 14, and you'll notice that it also has another deposition exhibit on it for Dr. Connolly.
A Uh-huh. 09:58AM
Q Can you identify that document, sir?
A It's a USGS document that was published in 2007.
Q What is -- I'm sorry. Excuse me.
A The title is Trends in Nutrient and Sediment 09:58AM Concentrations and Loads in Major River Basins of the South-Central United States 1993 to 2004.
Q Are you familiar with this document, sir?
A No, I'm not.
Q You did not review this document as part of 09:59AM your evaluation in this case?
A Let me check who the authors were. I don't recall reviewing this document, no.
Q Okay. Does this water quality information that's expressed here in this Exhibit 14 to your 09:59AM

deposition include an evaluation of water quality in the Illinois River basin?
MR. BOND: Object to the form.
A Does this report?
Q Yes. 09:59AM
A I can't answer the question. I don't know what's in this report. All I know is the title.
Q Would you look at Page 3, sir?
A Yes. I'm on Page 3.
Q Would you read the title of Figure 2, please? 10:00AM
A States, Cities and Major Rivers in the Study Area South-Central United States.
Q And does that figure include the Illinois River basin as part of the study area?
A Yes, it does. 10:00AM
Q Would you look with me, sir, on -- in the abstract of this paper. It's a few pages earlier.
A Yes. I'm there.
Q Under the abstract in the first paragraph in the middle, would you read the sentence beginning 10:00AM with trends?
A Trends observed in this study area were compared to determine potential regional patterns and to determine cause-effect relations with trends in hydrologic and human-induced factors, such as 10:01AM

nutrient sources, stream flow and implementation of best management practices.
Q Okay. Would this type of analysis be relevant to the Illinois River basin?
MR. BOND: Object to the form. 10:01AM
Q In your opinion, sir?
MR. BOND: Same objection.
A The material that this sentence describes would appear to be relevant to the Illinois River watershed, but all I know is the sentence I've read. 10:01AM I don't really know what is in the report, so I can't comment on whether the contents of the report are actually in fact relevant.
Q Okay. On the column to the right of where you just read -- 10:02AM
A Yes.
Q -- there's a discussion in the middle of that top paragraph concerning population. It says, although population increased. Would you please read that, sir? 10:02AM
A Although population increased throughout the study area during the study period, there was no observed relation between increasing trends in nitrogen in study area streams and increasing trends in population. 10:02AM

data in the IRW when he provided the inputs for initial soil phosphorus concentrations in his GLEAMS model.

Q Have you ever, sir, reviewed soil test phosphorus data for use in a runoff model? 10:56AM

A I've reviewed the materials produced in this case.

Q Prior to the review of this case, have you ever done that analysis in a modeling framework?

A No. 10:56AM

Q You cite on this page Knisel, Knisel and Davis paper I think from the GLEAMS manual.

A It's the GLEAMS manual.

Q Would you read the last sentence of the italicized portion there for the Record, sir? 10:57AM

A Did you say the very last sentence?

Q Yes, model users.

A Model users are strongly, underscore, urged to make every effort to obtain the best estimate possible for these parameters, which may involve 10:57AM soil sampling and analysis.

Q Okay. What did the authors of that paper mean by the best estimate possible --

MR. BOND: Object to form.

Q -- if you know? 10:57AM

A Well, I think I do know because there's more to that paragraph. The sentence above it points out that initial values of different conceptualized pools are very site specific and are generally very management dependent. This is especially true for 10:57AM systems with animal waste production -- excuse me, application, those with intensive management, such as high levels of fertility and production, and conservation tillage systems with heavy residues left on the soil surface. And the intent of this 10:58AM paragraph is to advise GLEAMS model users to use site-specific data to obtain the best available information for those parameters.

Q Does it actually say you have to use site-specific data to get the best estimate possible? 10:58AM

A Well, it says initial values are very site specific, and then it says model users are strongly, underscore, urged to make every effort to obtain the best estimate possible, which may involve soil 10:58AM sampling and analysis. My sense of this paragraph says, yes, site-specific data should be used, especially if these data are available and, in fact, this statement even suggests that if those data are not available, additional soil sampling and analysis 10:59AM

should be conducted.

Q Does it say should be or say may?

A May, excuse me, it may involve.

Q So you've interpreted it differently than what the actual word stated, have you not; you've taken your own interpretation of these records? 10:59AM

A Sir, all I did was make a mistake and used the word should instead of may. Everything I said prior to that point still stands on its own.

Q Have you ever done any GLEAMS modeling to determine whether or how this type of information that's discussed here from the Knisel paper is important to the analysis? 10:59AM

MR. BOND: Object to the form.

A I personally have exercised Dr. Elm's -- 10:59AM excuse me, Dr. Engel. I apologize again. I personally have exercised Dr. Engel's GLEAMS model of the IRW for the actual condition periods -- the actual condition period 1997 through 2006 for each of the three subwatersheds. I have not personally 11:00AM done simulations where I have done a formal sensitivity analysis on the STP concentrations in the model.

Q How would you relate your experience on fields runoff modeling compared to the experience of Dr. 11:00AM

Engel?

A I have as much experience running his model, his GLEAMS model of the IRW as he claimed to have had in his deposition. I've run it about a half a dozen times. 11:01AM

Q I move to strike as not responsive. Let me ask the question again, Dr. Bierman. How much experience do you have with runoff modeling, land runoff modeling compared to Dr. Engel's experience; would you say they're comparable? 11:01AM

A I won't quantitate it, but Dr. Engel has more experience doing that kind of modeling than I have.

Q Okay. Would you pull out Exhibit No. 5, sir? It's the paper by Keith Willett.

A Yes, I have it. 11:03AM

Q Would you -- would you identify again for the Record what this paper is?

A It's a paper published in the Journal of Environmental Planning & Management 2006. The title is The Opportunity Cost of Regulating Phosphorus 11:03AM From Broiler Production in the Illinois River Basin, Keith Willett, senior author.

Q Would you turn with me to Page 198?

A Yes. I'm there.

Q Would you look with me at the first full 11:04AM

paragraph where it says, the initial per-acre soil test phosphorus?
A Yes.
Q Would you read those two sentences there, sir?
A The initial per-acre soil test phosphorus 11:04AM
values for each of the counties included in the
modified optimization model are shown in Table 11.
These values were based on soil test analyses done
by the Cooperative Extension Service Offices with
Oklahoma State University and the University of 11:04AM
Arkansas.
Q So the modelers in this case used that dataset from those two universities for STP values within the IRW?
A Well, those two sentences say that that's what 11:04AM
they did.
Q Is that the same information that Dr. Engel employed for his IRW model?
A Just from looking at this, I don't know, but
it could be. 11:05AM
Q Okay. Are these -- is this dated -- was this then dated and used by the authors of this paper to evaluate county-wide STP levels which were inputted into their model?
A Well, again, all I know is that the authors 11:05AM

state, in the two sentences that you asked me to
read, is that they used the table -- the data in
Table 11 for their initial soil test phosphorus
values in their model.
Q So you're not sure whether they used them in the same fashion as Dr. Engel used them? 11:05AM
A Well, no. I haven't read this paper. I would
have to read the entire paper to know what the
context is and exactly what they did.
Q On Page 10 of your report, sir, the first full paragraph where it begins, Dr. Engel completely ignored all site-specific measurements for soil phosphorus in samples collected by the plaintiffs. What's your basis for that statement, sir? 11:05AM
A He told us what his -- in his expert report it 11:06AM
explained what STP concentrations he used. They
were in Table 7.1 of his expert report, and they
also appear in Page D-16, and they're contained in a
spreadsheet as indicated in the paragraph above what
you've just asked me to read. 11:06AM
Q So what do you mean by completely ignored?
A The data in the soil phosphorus samples
collected by the plaintiffs were in a separate
dataset. They were separate samples. They were
separate data from the STP concentrations, the 11:07AM

county level concentrations that Dr. Engel
references as having used in his expert report. He
did not state in his expert report that he used any
of the soil test phosphorus samples collected by the
plaintiffs, and in our investigation of his input 11:07AM
files, we could not determine that he had used these
data.
Q Do you know whether he evaluated this data against the data he did input to determine whether his data that was inputted from the university datasets reasonably represented the information that was collected by the State in this case? 11:07AM
MR. BOND: Object to form.
A He didn't -- in his expert report, he made no
such statement that he did that. Whether he 11:08AM
actually did it or not, I don't know.
Q Let's go down a couple more paragraphs on Page 10 where it says, in his deposition. Would you read that short paragraph for the Record?
A In his deposition on January 8 and 9, 2009, 11:08AM
Dr. Engel acknowledged that he did not have a single
datum from the State of Arkansas, approximately half
of the IRW, to support his assumptions on soil
phosphorus levels.
Q What's your point here? 11:08AM

A My point is simply that Dr. Engel stated that
he did not have a single soil test phosphorus
measurement to support the assumptions he made on
phosphorus levels for his model, which represented
major portions of the state of Arkansas, which is 11:09AM
approximately half the IRW, and that he didn't have
data to support those assumptions for a large
portion of the area that he modeled.
Q Are you suggesting that Dr. Engel had no phosphorus soil data for the state of Arkansas in his model? 11:09AM
A I just know that --
MR. BOND: Object to the form.
A Excuse me. I'm simply stating here what he
stated in his deposition. 11:09AM
Q Was Dr. Engel referring in that statement in his deposition to background soil test data?
A I can't recall sitting right here.
Q Do you know whether or not there is a field or pasture in the state of Arkansas that has not had poultry litter applied to it? 11:09AM
MR. BOND: Object to form.
A I'm sorry. Please clarify that.
Q Do you know whether there's any pasture in the state of Arkansas within the IRW that has not 11:10AM

received poultry waste?
MR. BOND: Same objection.
A In my reading of the materials in this case, it's my understanding that poultry litter has been applied to many pastures in the IRW but not all of them. That's the extent of my knowledge. 11:10AM
Q And how do you know that it has not been applied to all of them?
MR. BOND: Object to form.
Q Within the state of Arkansas, what's your basis for that belief? 11:10AM
MR. BOND: Object to form.
A Dr. Engel's report states that -- he mentions several locations and states that the phosphorus concentrations at these locations would represent background levels because poultry litter was never applied or had not been applied for a long time or something to that nature. 11:11AM
Q Those references in Dr. Engel's report relate to the Nickel Preserve, which is in the state of Oklahoma; is that not correct? 11:11AM
A That's correct.
Q Okay. So how can you -- what's the form of your basis that there has been fields within the state of Arkansas portion of the IRW that have never received poultry waste? 11:11AM

336

A I don't believe in my answer I included the statement that they were in the state of Arkansas. I said in the IRW, my understanding is that there have been fields that received poultry litter and fields that have not. 11:11AM
Q Do you know how difficult it was for the State's experts in this case to identify any fields within the IRW that had not received poultry waste?
MR. BOND: Object to form. 11:12AM
A No, I don't. I don't have any knowledge of what the plaintiffs did to identify -- I don't have any knowledge of that, no.
Q So if this deposition statement that we just read a few minutes ago, on January 8th and 9th if Dr. Engel was referring to background soil test phosphorus levels from the State of Arkansas, would that explain the issue here that you're trying to criticize? 11:12AM
MR. BOND: Object to the form. 11:12AM
A I don't know. I would have to go back and read Dr. Engel's deposition to determine if that would be the explanation.
Q Let's look at the bottom of Page 10, the paragraph that begins not only. 11:12AM

337

A Yes.
Q Would you read that first sentence, please?
A Not only did Dr. Engel ignore most of the available data in the IRW when he provided the inputs for soil phosphorus concentrations in his GLEAMS model, including data collected by the plaintiffs, he failed to document the values he actually used in his GLEAMS model for background soil phosphorus concentrations in the absence of applied poultry litter. 11:13AM
Q Okay. Let's start with the first part of that statement. What do you mean by Dr. Engel ignored most of the available data concerning soil test phosphorus concentrations?
A He did not use those data to specify the initial soil phosphorus levels in his -- as the initial conditions. 11:13AM
Q How did you quantify most; do you know how much soil test phosphorus data is available within the IRW? 11:14AM
A I don't recall how many soil test phosphorus measurements were collected. I know that he ignored all 190 measurements of STP collected by the plaintiffs.
Q But you're not just talking about the 11:14AM

338

plaintiff here; you made a blanket statement that said most of the available data in the IRW was ignored by Dr. Engel. Do you know what quantum of data that 190 samples collected by the State's experts represents to all the soil test phosphorus data in the IRW? 11:14AM
MR. BOND: Object to the form.
A I know that he used county-wide averages for five or six counties, highly summarized numbers, and ignored the 190 measurements of STP collected by the plaintiffs. 11:14AM
Q Do you know how many data points Dr. Engel received and used to create those county-wide averages?
A Not sitting here, I don't, no, sir. 11:15AM
Q So how can you support your statement that he ignored most of the available data in the IRW soil test phosphorus?
A I didn't quantitate the 190. I quanti -- I didn't quantitate the 190 compared to every soil test datum in the IRW. I made that statement based on his use of five or six numbers, which represented very large areas and did not represent the spatial differences among his different land use areas and IRUs, and failed to use the 190 measurements 11:15AM 11:16AM

339

sorry. Second sentence, he goes on to state that point to non-point sources of phosphorus of significance, in paren, greater than 2 percent of P based on mass balance will be considered. Apparently that was his criterion for deciding what to include. 11:23AM

Q Okay. Do you have any basis, independent basis to dispute whether or not any of these sources you listed on Page 11 have greater than a 2 percent contribution of phosphorus to the IRW streams and rivers? **11:23AM**

A I've conducted no independent analysis of the magnitudes of any resources. My criticism did not pertain to the 2 percent criterion. I'm simply pointing out the fact that I listed the loadings Dr. Engel included and I listed the loadings that Dr. Engel did not include, and those are matters of fact. 11:23AM

Q But you don't have any concept as you sit here today as to whether or not any of these sources you list produce a significant contribution of phosphorus to the IRW? **11:24AM**

MR. BOND: Object to form.

A Well, the words concept and significant are vague and undefined. All I can tell you is I did 11:24AM

not quantitate any of these sources, but I can point out, for example, let's just take stream bank erosion, septic systems, recreation activities, nurseries, gravel mining, illegal dumping, smaller livestock facilities and wildlife. That is one, two, three, four, five, six, seven, eight categories just in my bulleted list. If, for example, each of those categories was 2 percent, then 8 times 2 percent is 16 percent. It's conceivable, and if we want to call them 1.99 percent, it's conceivable that the sum of those sources could account for almost 16 percent of the total phosphorus load, and if that is the case, and I don't know it to be the case, that would be a significant portion of the inputs that would have been ignored. 11:24AM 11:25AM 11:25AM

Q So you define significant phosphorus as 16 percent. So in your opinion, sir, a contributor of phosphorus of 16 percent to the IRW would be significant?

MR. BOND: Object to the form. 11:25AM

A All I'm trying to say -- no, I'm not saying that at all. I'm trying to say that if one is trying to do a mass balance of total phosphorus, one would not want to ignore -- if one had data for, one would not want to ignore 16 percent of the input 11:25AM

loadings, and in Table B of -- in Appendix B of Dr. Engel's report, he did in fact have loadings for other sources besides the sources he included in his model, and my point is that he applied his 2 percent -- he stated his 2 percent criteria, but did not, for example, investigate what the sum total of the sources he ignored would be if each of them was close to the 2 percent limit. That is my point, sir. 11:26AM

Q How much contribution is represented by stream bank erosion to the IRW? **11:26AM**

A As I stated previously, sir, I've not quantitated any of these sources.

Q Would in your opinion stream bank phosphorus include phosphorus that had been applied as a fertilizer or manure? **11:26AM**

A It would depend on the site. It would depend on the conditions. I can't give a one size fits all answer to that question.

Q What contribution of phosphorus is represented by septic tank systems in the IRW? **11:27AM**

A I don't know. I've not quantitated that.

Q Recreational activities?

A As I stated, sir, I've not quantitated any of these. 11:27AM

Q Nurseries, gravel mining, illegal dumping would be the same?

A I've not quantitated them.

Q Do you know whether or not there's even any illegal dumping of phosphorus containing materials within the IRW? **11:27AM**

A My understanding is that claims of illegal dumping have appeared in some of the defendants' expert reports, but I personally have no knowledge of illegal dumping nor have I conducted any investigation of illegal dumping. 11:27AM

Q Below that list on Page 11, the last sentence of this page of your report reads stream bank erosion and sediment loads from unpaved roads are important sources because phosphorus binds tightly to soil and sediment particles. What's your basis for your conclusion that stream bank erosion in phosphorus from unpaved roads are important sources of phosphorus in this system? **11:28AM**

A The meaning of that sentence is as follows: Stream bank erosion and sediment -- it makes the point that stream bank erosion and sediment loads are not just about solids. As we discussed earlier in this deposition, phosphorus binds to solids, and the meaning of that sentence is that where you have 11:28AM

the total amount of phosphorus that was calculated in Dr. Engel's mass balance for poultry, number of pounds?
A No, I don't.
Q Do you recall whether it was on the order of about 9 million pounds per year based on waste? 12:49PM
A I stated I don't recall it, so I can't --
Q When you cited Dr. Jarman's information on Page 11 of your report concerning phosphorus contributions from land-applied biosolids, such as wastewater treatment plant sludges and bypasses, did you compare those phosphorus amounts to the information either in Dr. Engel's mass balance approach that he presented or the information in Mr. Meo's paper shown on Exhibit 17 to see whether those contributions that are reported by Jarman were significant? 12:49PM
A I didn't compare the two numbers because the point of my supporting statement 2D is simply that Dr. Engel failed to include these sources in his GLEAMS model. 12:50PM
Q Do you think it's reasonable for a modeler to determine contributions to source to include all sources even if they're so small as to be negligible and not have an impact on the modeling results? 12:50PM

MR. BOND: Object to the form.
A That judgment would depend on the site. It would depend on the objectives of the modeling. It would depend on the quantity and quality and availability of the data, and it would depend on the purposes for use of the model results. I cannot give a one size fits all answer to that question as posed. 12:50PM
Q Do you recall what Dr. Jarman reported were the phosphorus contents of land application from wastewater treatment plants? 12:51PM
A No, I do not.
Q Let me hand you what we've marked as Exhibit 18 and if you could identify that for me, sir.
A This is a cover page to the expert report of Dr. Ron Jarman. It's dated December 1st, 2008. 12:52PM
Q Okay. I've included pages of this report -- well, would you have reviewed this report, correct, Dr. Jarman's report?
A No. I read sections of this report. I did not read the entire report, nor did I review it in detail. 12:52PM
Q Okay. Well, did you review the sections where Dr. Jarman discussed contributions from -- of phosphorus to the IRW from land-applied POTW waste? 12:52PM

A I forget what sections I read. I read -- I read the portion or portions of his report in which he stated that there was land application of biosolids from WWTPs and that there were -- are WWTP bypasses and overflows in the IRW. That's the only information I gleaned from his report pertaining to my supporting statement 2D. 12:53PM
Q Okay. When you suggested that Dr. Engel should include wastewater treatment plant biosolid application and bypasses, with regard to the wastewater treatment plant biosolid applications, were you assuming that the application of biosolids within the IRW, i.e., phosphorus, from those application areas would run off during rainfall events? 12:53PM
A I didn't make any assumption about the transport, delivery or fate of these loads. I simply pointed out the fact that Dr. Engel had not included those as sources in his model inputs.
Q Do you know how the phosphorus represented by Dr. Jarman in his report of biosolids application compares to the phosphorus in poultry waste generated in one year? 12:53PM
A No, I don't.
Q Would you look at Table 6 of this Exhibit 18, sir, about the fourth page of the exhibit. I'll represent to you this is Table 6 from Dr. Jarman's report, who reports the phosphorus from land-applied biosolids within the IRW. Can you tell me -- the most recent year is 2006; is that correct? 12:54PM
A In this table, yes.
Q Okay, and what does that show total biosolids to be?
A The land-applied biosolids in the IRW from POTWs in 2006 from Table 6 of Dr. Jarman's report is 52.41 tons. 12:54PM
Q Okay, and approximately how many pounds is that, sir?
A If they're English tons, as they probably are, it would be 52 times 2,000. 12:55PM
Q So around a hundred thousand, 104,000 pounds?
A Approximately.
Q Okay. Do you know how that compares to poultry contribution?
A No, I don't. 12:55PM
Q If I told you that the mass balance for poultry manure applications in the IRW was determined to be 9 million pounds, how would that compare to the 104,000 pounds represented by Dr. Jarman as land-applied biosolid phosphorus? 12:55PM

the IRW have changed substantially over the last some decades. That's just common sense to me.

Q Oh, really? Well, are you aware, sir, that most of those default parameters relate to soil processes and not whether or not the land use has changed? 01:14PM

MR. BOND: Object to the form.

Q Your example was urbanization has changed, but do any of those default parameters relate to urbanization changes or aren't they in fact simply parameters that describe soil processes? 01:15PM

MR. BOND: Object to the form.

A There are many different parameters that describe soil processes and other processes as well. I have listed these parameters. 01:15PM

Q You've listed the default parameters in your report that you have concern with?

A I have concern with all 130 of the default parameters that Dr. Engel used because they were not supported and/or based on data that are not specific 01:15PM to the IRW and/or represent conditions pre- 1980.

Q Sitting here today, you can't identify one single parameter of those 130 that you have a concern with?

MR. BOND: Object to the form, asked and 01:15PM

380

answered.

A I believe I've adequately answered your question, Mr. Page.

Q Can we turn to Page 15 in your report, sir?

A Yes. I'm there. 01:17PM

Q Would you read supporting statement 2F, sir?

A Yes. In contravention to generally accepted practices in the scientific community, Dr. Engel did not compare the predictions for hydrology from his GLEAMS model to any observed data in the state of 01:17PM Arkansas or to most of the observed data in the state of Oklahoma.

Q Okay. Can you provide me a peer-reviewed article that supports that statement that you made in 2F? 01:17PM

MR. BOND: Object to the form.

Q Provide me a citation to a peer-reviewed article that supports the statement --

A I don't need a peer-reviewed scientific article to support that statement, sir. When one 01:17PM develops and applies a site-specific model, it is certainly not common practice to ignore 79 percent of the hydrology measurements if one has developed and calibrated and purported to validate a hydrologic model. 01:18PM

381

Q So you can't provide me with any references that indicate that the amount of climate data that Dr. Engel used in this case was inappropriate for his use in the IRW?

A That wasn't my statement, sir. 01:18PM

Q Okay. Can you provide me any information?

MR. BOND: Object to the form.

A Please state the question again.

Q Can you provide me a peer-reviewed article that suggests that the quantum of data that Dr. Engel used with regard to climate information was inappropriate for the IRW? 01:18PM

MR. BOND: Object to the form.

A If by climate, are we talking of hydrological data or climate data? In any case, I don't need a 01:18PM peer-reviewed publication to tell me that in the development and calibration of a watershed model, that a modeler should ignore most of the available precipitation data. I can't find the number at the moment, and 79 percent of the available hydrologic 01:19PM measurements with which to calibrate the model, especially given the high stakes, the serious consequences, the large claims and the rigor and QA/QC demanded by a litigation case such as this.

Q Did you do any sensitivity analysis to see whether the additional rainfall data would have been -- had an effect on the modeling results? 01:19PM

382

A No, I did not.

Q Given the high stakes involved in this case, why didn't you do that evaluation? 01:19PM

A Because it was Dr. Engel's model. It was incumbent upon him to use the available data. It was not incumbent on me to recalibrate his model, correct it, do it over or input all of the available data that he should have input in developing his 01:20PM model to support his claims in this case.

Q So you believe it's not incumbent upon you to support your claims of mistakes?

MR. BOND: Object to the form.

A I disagree that I'm mistaken in this matter, 01:20PM and my claim is simply -- and let me find the statement Dr. Engel ignored 73 percent of the available rainfall data.

Q Okay, but you've done no sensitivity analysis that would have an impact on his model; correct? 01:20PM

A I don't need sensitivity analyses to tell me that -- to support my claim that Dr. Engel could have and should have used the additional -- the rainfall data -- let me say it this way: Dr. Engel should not have ignored 73 percent of the available 01:21PM

383

rainfall data.
Q What's your basis for that?
A I don't need a --
Q If you don't have a sensitivity analysis, what's your basis for the fact that that was important to the amount of model output that Dr. Engel produced? 01:21PM
MR. BOND: Object to the form.
A On Page 9 of my expert report, the first paragraph, Shoemaker, et al, 2005, state ultimately input of time varying and spatially detailed meteorological information can support more accurate calibration and application of watershed models, particularly in the prediction of hydrology. Hydrology is particularly sensitive to variations in spatial distribution of precipitation and temperature. The use of these additional data -- when Dr. Engel ignored 73 percent of the available data, it wasn't just quantity of data that he ignored. He ignored data in different spatial locations that would have allowed him to more accurately represent variations in spatial distribution of precipitation and, again, sir -- 01:21PM 01:21PM 01:21PM
Q Would it have --
A Please let me finish my answer. It was his 01:22PM

model and it was his responsibility to use those data. It was not my responsibility to conduct sensitivity analyses of his model after the fact.
Q Was the model inaccurate on predicting loads to -- let me just ask: Was the model inaccurate? 01:22PM
A That's a broad question. I can't answer that question. Please be more specific.
Q Was -- how can you support your position that the spatial variations that may be represented by additional climate data would have influenced the determination of the relative contributions of phosphorus to Lake Tenkiller from the different sources within the IRW? 01:22PM
A I didn't claim it would. I'm simply pointing out that Dr. Engel ignored 73 percent of the rainfall data. I did not conduct sensitivity analyses to determine what the consequences of using all of the rainfall data would have been on the phosphorus loads computed by the model. Again, sir, it was not my model. 01:23PM 01:23PM
Q When you did your work for the Everglades, did you use all of the available climate rainfall data for that model?
A My recollection is that we used all of the available rainfall data from the South Florida Water 01:23PM

Management District. They provided those data to us.
Q Did you determine whether that was all of the available data or just a select portion?
MR. BOND: Object to the form. 01:24PM
A I can't recall, but knowing how the South Florida Water Management District operates, I'm sure it included all of the appropriate data.
Q All of the appropriate data but not necessarily all of the data that's available; is that what you're testifying to today, sir? 01:24PM
A By the appropriate data, I mean all of the precipitation data that would have been relevant and applicable to that model application and that spatial domain. 01:24PM
Q What evidence do you have that Dr. Engel did not use all relevant and appropriate data for the application to the model he's prepared for the IRW and the purposes for which that model was prepared?
A He ignored 73 percent of the data and did not explain why and did not explain in -- his expert report did not support his decision to ignore these data. Again, sir that was incumbent upon him. It's his model. 01:24PM
Q Did you ask counsel during Dr. Engel's 01:25PM

deposition to inquire as to Dr. Engel's selection of rainfall data and his basis?
A I can't recall.
Q What about the other hydrological data that's represented in 2F; did you ask counsel to inquire of Dr. Engel during his deposition why he did not use all of the available hydrologic data as you claim in statement -- 01:25PM
MR. BOND: Object to the form.
A I can't recall. 01:25PM
Q Does Dr. Engel do site-specific calibration for his modeling, that is, use site-specific information to calibrate his model?
MR. BOND: Object to the form.
A Which model? 01:25PM
Q The GLEAMS model with the routing application.
A Is it the GLEAMS model, the routing model or both? I want to understand the question.
Q Both together. Does he use site-specific information to calibrate the GLEAMS and routing model together? 01:26PM
A To calibrate and purportedly validate his GLEAMS and routing models, Dr. Engel used flow data and has computed phosphorus loads at three USGS stations, the last three stations just above the -- 01:26PM